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IS 8034 (2002): Submersible Pumpsets - Specification [MED
20: Pumps]



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भारतीय मानक
निमज्जनीय पम्पसेट — विशिष्टि
(दूसरा पुनरीक्षण)

Indian Standard
SUBMERSIBLE PUMPSETS — SPECIFICATION
(Second Revision)

(First Reprint OCTOBER 2003)

ICS 23.100.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Pumps Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1976 and revised in 1989. The major changes in the first revision were:

- a) Nomenclature for radial flow and mixed flow pumps,
- b) Manufacturing and quality aspects were better detailed, and
- c) A graph for overall minimum efficiency for 2-pole motors was included so as to promote energy conservation. For 4-pole motor, the details were still being worked out and were to be added later on. The efficiency values were again to be reviewed, upgraded after three years.

Since then 5 amendments were issued.

In this revision, all the amendments have been reviewed and incorporated. Terminology of static water depth, draw-down and submergence have been modified. Some of the constructional features have also been modified in line with the prevailing manufacturing practices.

A large number of data relating to pump efficiencies were collected to assess the possibility of increase in efficiency. After analyzing the data and considering the scope for increase, minimum efficiency has been increased by five percent over the existing pump efficiency values.

It has been experienced that the pumps are certified at one particular duty point, being the best efficiency point but the requirements of user may be of pump of duty point different than the certified duty point which may otherwise fall within the specified head and discharge tolerances and the same pump without any alteration may also meet the performance requirements at user's required duty point. To cover certification of such pumps without testing again, the concept of 'Nominal Rating' for the duty point has been introduced in this revision. On this nominal rating, specified tolerances may be made applicable so that there is no need to test the pump again at user's required duty point which fall within the tolerance and may be certified as such provided the pump meets all other requirements of standard at the user's required duty point. However, it would be desirable and more useful to apprise the user that certified pump at user's required duty point may conveniently be used, if within the specified tolerance of 'Nominal' duty and meeting other performance characteristics at user's required duty point rather than certifying the same pump again at user's required duty point.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 2 MAY 2006
TO
IS 8034 : 2002 SUBMERSIBLE PUMPSETS —
SPECIFICATION

(Second Revision)

[*Page 4, clause 7.1, fifth and sixth line*] — Substitute the following for the existing:

“over load test [16.1(m)], vibration test [16.1(n)], temperature rise test [16.1(j)] and temperature rise at reduced voltage test [16.1(k)] as per IS 9283. Temperature rise test however shall be done as per 7.1.1. The temperature rise test at reduced voltage as per 7.1.1.2 shall not be applicable for category ‘A’ Submersible motors.”

[*Page 7, clause 14.1.2.1*] — Substitute the following for the existing text:
‘Measurement of flow shall conform to 3.1.1 of IS 11346.’

[*Page 8, clause 14.1.3.1(c)*] — Substitute ‘ $V_d^2/2g$ ’ for ‘ $Vd^2/2g$ ’.

(MED 20)

**AMENDMENT NO. 1 JUNE 2003
TO
IS 8034 : 2002 SUBMERSIBLE PUMPSETS —
SPECIFICATION**

(Second Revision)

(Page 8, clause 15.3, first line) — Substitute '8' for '7, 7.1 and 7.2'.

(MED 20)

Printed at Prabhat Offset Press, New Delhi-2

Indian Standard

SUBMERSIBLE PUMPSETS — SPECIFICATION

(Second Revision)

1 SCOPE

This standard prescribes the technical requirements for submersible pumpsets commonly used in boreholes (borewells or tubewells) for handling clear, cold water.

2 REFERENCES

The Indian Standards listed at Annex A contain provisions which, through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards.

3 UNITS AND TERMINOLOGY

In addition to the units and terminology specified in 2 and 3 of IS 5120, the following shall also apply.

3.1 Static Water Depth

It is the depth of water level below the ground level when the pump is not in operation.

3.2 Draw-Down

It is the elevation difference between the depth of static water level and the consistent standing water level in tube well during pump in operation.

3.3 Submergence

It is the minimum height of water level after draw-down above the suction casing.

4 CHARACTERISTICS OF CLEAR, COLD WATER

Clear, cold water shall mean water having the characteristics specified below:

- | | |
|---------------------|-------------------------------------|
| a) Turbidity | : 50 ppm (silica scale), <i>Max</i> |
| b) Chlorides | : 500 ppm, <i>Max</i> |
| c) Total solids | : 3 000 ppm, <i>Max</i> |
| d) pH value | : 6.5 to 8.5 |
| e) Temperature | : 33°C, <i>Max</i> |
| f) Specific gravity | : 1.004, <i>Max</i> |
| g) Hardness | : 300, <i>Max</i> |
- (drinking water)

NOTE — If the characteristic of water differ from these specifications, the pump constructional details shall be agreed between the manufacturer/supplier and the user. In such cases, the characteristics shall be specified in the order.

5 NOMENCLATURE

Nomenclature of the parts commonly used in submersible pumpsets shall be as given in Fig. 1.

6 CONSTRUCTIONAL FEATURES

6.1 General

The submersible pumpsets described herein generally comprise the following:

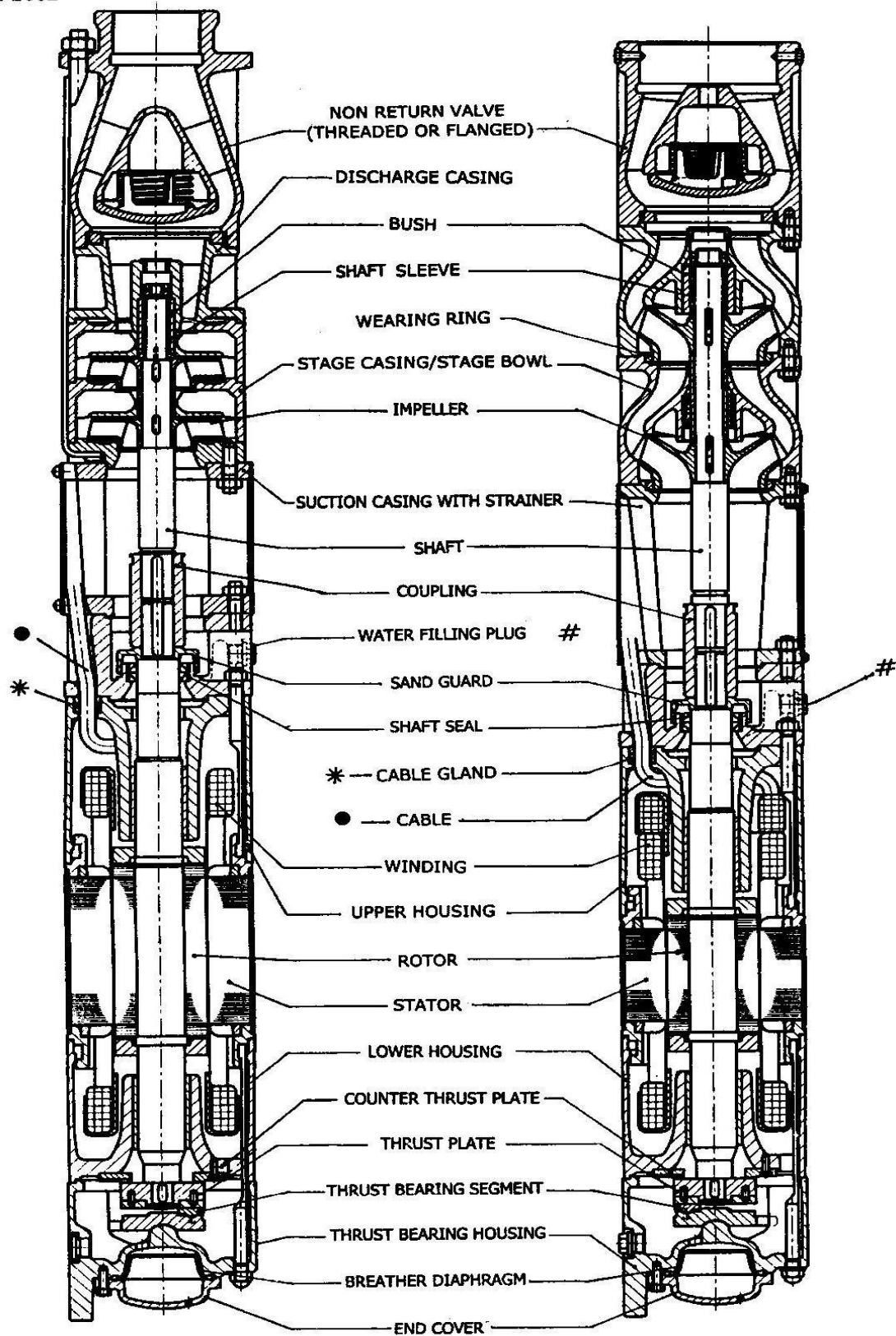
- a) Pump sub-assembly,
- b) Motor sub-assembly,
- c) Coupling,
- d) Non-return valve,
- e) Discharge casing (if provided) either integral or separate, and
- f) Cable and cable guards.

6.2 Material of Construction

6.2.1 There are number of recognized materials of construction available to meet the needs of submersible pumpsets handling clear, cold water. Typical material for few components are indicated below merely for guidance of the manufacturer and user:

<i>Sl No.</i>	<i>Component</i>	<i>Material of Construction</i>
1.	Shaft sleeve	Bronze grade LTB 2, 3, 4 or 5 of IS 318 or 12 percent chromium steel grade X 04 Cr 12, X 12 Cr 12 and X 20 Cr 13 conforming to IS 6911 or IS 6603
2.	Casing wear ring (if provided)	Bronze grade LTB 2, 3, 4 or 5 of IS 318
3.	Bush	Bronze grade LTB 2, 3 or 4 of IS 318 or Nitrile/cutless rubber
4.	Discharge casing (if provided)	Cast iron grade FG 200 of IS 210
5.	Impeller	Bronze grade LTB 2 of IS 318 or Stainless steel grade X 12 Cr 12 of IS 6911 or IS 6603
6.	Pump bowl/diffuser	Cast iron grade FG 200 of IS 210
7.	Pump shaft	Stainless steel grade X 04 Cr 12, X 12 Cr 12 or X 20 Cr 13 of IS 6603
8.	Suction casing	Cast iron grade FG 200 of IS 210

NOTE — The materials listed are to be considered as only typical and indicative of minimum requirements of the material properties. The use of materials having better properties is not prejudiced by the details above provided materials for components in bearing contact with each other do not entail galling, corrosion, magnetic induction, etc.



1A RADIAL FLOW PUMP

1B MIXED FLOW PUMP

NOTE — These figures only illustrate the nomenclature of commonly used parts and does not specify any particular design feature.

FIG. 1 NOMENCLATURE OF SUBMERSIBLE PUMPSETS IN GENERAL

6.2.2 To benefit from the advancement in technology of plastics, thermoplastic materials, such as, polyphenylene oxide (PPO), polycarbonate, acetal, nylon 66, PTFE, ABS, polyester PETP, etc, may be

used for pump parts like shaft sleeve, casing, impeller wearing ring, bowl/diffuser, etc. However, typical materials of the main parts are indicated below for the guidance of the manufacturer and the user:

<i>Sl No.</i>	<i>Name of the Part</i>	<i>Material</i>	
1.	Impeller	Glass filled polyphenylene oxide ¹⁾ (modified PPO), glass filled polycarbonate ¹⁾ properties shall be as given below:	
	Properties	Modified Polyphenylene Oxide	Polycarbonate
	Hardness (Rockwell)	M 90/L 106	M 91
	Coefficient of linear, $m/m^{\circ}C$ thermal expansion	4×10^{-5} , Max	3×10^{-5} , Max
	Water absorption, 24 h at 23°C, percent	0.06, Max	0.29, Max
	Notched impact strength Izod, J/m	80, Min	100, Min
	Specific gravity	1.21 ± 0.03	1.35 ± 0.03
	Tensile strength at break, N/mm ²	90, Min	90, Min
	Elongation at break, percent	4-6	3
	Mould shrinkage, percent	0.2-0.4	0.2-0.5
	Glass content, percent	20, Min	20, Min
2.	Bowl/diffuser	Polyphenylene oxide (modified PPO), polycarbonate, polyacetal or polypropylene	
3.	Wearing ring	PTFE, ABS or Nylon 66	
4.	Shaft sleeve	Polyethylene (LD/HT), Nylon 66, PTFE, polypropylene	

¹⁾ Glass filling is extremely essential for these grades of plastics in view of abrasion resistance and better life to the end users.

6.3 Typical Design Features of Components of Pump for Guidance

6.3.1 The impellers may be of the enclosed or the semi-open type.

6.3.2 The pump shaft may be guided through bearings. Bearings may be provided in mixed flow pumps for each stage. In case of radial flow pump, bearings may be provided in suction and discharge casing, while in case of intermediate bearings, suitable positions may be selected in the overall span.

6.3.3 The inlet passages of the suction casing may be designed to reduce entry losses of the inlet flow.

6.3.3.1 The strainer on the suction casing may offer the best compromise between restraining the large solids from entering the pump and retaining the suction losses to the minimum.

6.3.4 The outer periphery of the pump casing may have provision for securing the cable and cable guards over the cable, so as to prevent damage to the cable.

6.4 Requirements for Components

6.4.1 The surface finish of shaft or shaft protection sleeve shall be $0.75 \mu m$ Ra Max pertaining to the bearing contact surfaces.

6.4.2 Each metallic impeller shall be dynamically balanced to Grade G 6.3 of IS 11723 (Part 1). The plastic and sheet metal impeller need not be balanced.

6.4.3 The manufacturer shall have a system of controlling dimensional accuracy within a scheme of fits and tolerance limits. The system shall help interchangeability and fitment at site of replacement spares during repair and maintenance.

7 TESTS FOR ELECTRICAL PERFORMANCE

7.1 Type Tests

Submersible motors shall conform to all the requirements of IS 9283. However, in case of pumpset, motor need not be tested for full load test [16.1 (g)], performance characteristics [16.1 (h)], momentary

overload test [16.1 (m)], vibration test [16.1 (n)] as per IS 9283 and temperature rise test as per 7.1.1.

NOTE — Minimum starting torque shall be as given in Table 1.

Table 1 Values of Performance Characteristics for 2-Pole 415 V, Three-Phase Submersible Motors for Borewell Size 100, 150 and 200 mm
(Clause 7.1)

Motor Rating	Maximum Current as per IS 9283	Permissible Limit of Maximum Current in the Operating Head Range for Checking the Non-overloading Requirements	Minimum Starting Torque (in Terms of Percentage of FL Torque)
(kW)	(Amp)	(Amp)	(percent)
(1)	(2)	(3)	(4)
1.1	3.25	3.48	125
1.5	4.50	4.82	125
2.2	6.50	6.96	125
3	8.50	9.09	125
3.7	10.00	10.70	125
4.5	12.00	12.84	125
5.5	14.50	15.52	125
7.5	19.50	20.87	125
9.3	25.00	26.75	125
11	29.00	31.00	125
13	34.00	36.38	125
15	39.00	41.73	125

NOTES

1 Maximum current limits specified are for 415 volt rated voltage. For other voltages, it shall be in inverse proportion to rated voltage.

2 For three-phase motors, the value of current shall be taken as average value of the current measured in three phases.

3 Performance values of 2-pole and 4-pole single-phase motors, 4-pole three-phase motors and that of motors less than 1.1 kW and exceeding 15 kW rating shall be as declared by the manufacturer.

4 Values given in col 3 are 1.07 times the values given in col 2.

7.1.1 Temperature Rise Test

Temperature rise test for winding shall be carried out on sample pumpset:

- at rated voltage and supply frequency, and
- at 85 percent of rated voltage and supply frequency.

7.1.1.1 Temperature rise test at rated voltage

Run the pumpset at rated voltage and at maximum current in the operating head range for 2 h. Stop the set and measure the winding resistance and water temperature within 30 s. Temperature rise computed by resistance method as per 19.2 of IS 9283 shall not exceed 35°C.

7.1.1.2 Temperature rise test at reduced voltage

Carry out this test immediately after test at rated voltage. Run the set at maximum current in operating head range at rated voltage. Reduce the voltage to 85 percent of rated voltage in this condition. Run the pumpset for 1 h and measure the winding resistance.

Temperature rise so computed shall not exceed 45°C.

7.1.1.3 Water temperature in both the above tests in 7.1.1.1 and 7.1.1.2 shall not exceed 45°C.

7.2 Routine Test

Tests as specified in 16.2 of IS 9283.

8 SUBMERSIBLE CABLE

The cable shall conform to 5.3 of IS 9283. The length of the cable shall be minimum 3 m unless otherwise specified by the customer.

9 PUMP ASSEMBLY

9.1 Hydrostatic test shall be carried out on pressure boundary part either individually or as a block assembly at a pressure of 1.5 times the maximum discharge pressure for a minimum duration of 2 min.

9.2 The pump may be equipped with replaceable bearing and wearing ring, wherever provided.

10 DIRECTION OF ROTATION

10.1 The direction of rotation of pumpsets is designated clockwise or anti-clockwise as observed when looking at the pump stage from the driving end.

10.2 The direction of rotation shall be clearly and securely marked by incorporating an arrow on the pumpset.

11 TYPICAL INSTALLATION

11.1 Since the motor and the pump are directly coupled, or closed coupled, the manufacturer shall indicate the minimum size of the borehole in which the submersible pumpset shall be erected and suspended freely.

11.2 The pumpset shall be installed as per guidelines laid down in IS 14536 or as per the recommendation of the manufacturer. A typical sketch of submersible pumpset installation is shown in Fig. 2. The construction of borewell shall conform to IS 2800 (Parts 1 and 2). The maximum outside diameter of pumpsets corresponding to nominal diameter of the tubewell is as given below:

Nominal Diameter of the Tubewell	Maximum Outside Diameter of Submersible Pumpsets
(mm)	(mm)
100	98
115	108
150	146
200	196
250	245
300	296

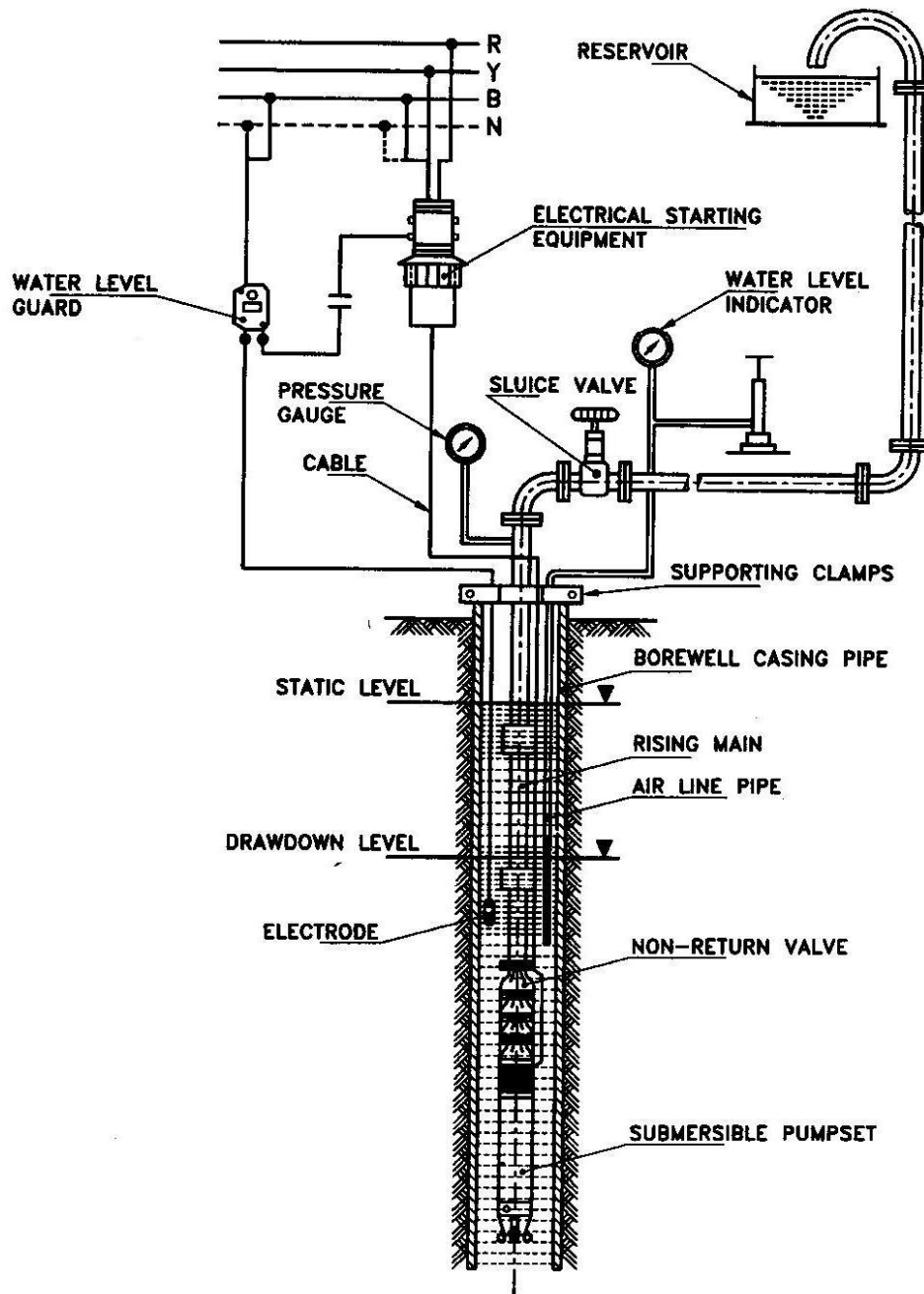


FIG. 2 TYPICAL SUBMERSIBLE PUMPSET INSTALLATION

11.3 The manufacturer shall specify the minimum submergence of pump unit at duty point.

12 INFORMATION TO BE FURNISHED BY THE PURCHASER

When enquiring or ordering pumps to this standard, the user may furnish the following information to the suppliers:

- a) Name of the purchaser,
- b) Address of the purchaser,

- c) Installation site,
- d) Number of pumps required,
- e) Spare parts required,
- f) Pump operating conditions:
 - 1) Capacity.....l/min, l/s or m³/h.
 - 2) Number of poles of motor.
 - 3) Total head, alternatively, sketch of the pipe line giving information, such as, static delivery pipe diameter and length, distance between point of discharge, pipe

fittings and valves used, etc, may be given.

- 4) Total depth of casing pipe.
 - 5) Static water depth.
 - 6) Tube well capacity at predicted draw-down.
- g) Description of the well:
- 1) Installation of the pump in:
 - i) open well,
 - ii) tube well,
 - iii) open well with a boring, and
 - iv) others.
 - 2) Minimum inside diameter of the tube well or casing pipe.
 - 3) Total depth of open well/deep well.
 - 4) Total depth of casing pipe.
 - 5) Static water depth.
 - 6) Well developed to.... l/min at.... metre draw-down.
- h) Site conditions:
- 1) Height above mean sea level in metres, and
 - 2) Details of quality of water with respect to all the characteristics as given in 4.
- j) Power supply:
- 1) Type of supply (single-phase/three-phase),
 - 2) Frequency (Hz),
 - 3) Voltage (V), and
 - 4) Variation in voltage/frequency.
- k) Accessories (state whether the following items are required):
- 1) Sluice valve,
 - 2) Reflux valve,
 - 3) Pressure gauge,
 - 4) Rising main pipe and delivery bend/elbow,
 - 5) Type of installation stages in the entire system,
 - 6) Water level indicator,
 - 7) Voltage stabilizer,
 - 8) Automatic starting and stopping device (optional),
 - 9) Starter—direct on the line or star-delta or indicate starting method,
 - 10) Voltmeter,
 - 11) Ammeter,
 - 12) Single phasing preventers,
 - 13) Water level guard, and

14) Low voltage protector.

NOTE — Serial No. 6 to 14 may be arranged in a separate control panel.

13 INFORMATION TO BE FURNISHED BY THE SUPPLIER

If purchaser demands, the supplier shall furnish the following information while supplying the pumpset to this standard.

- a) Type designation of pump and submersible motor,
- b) Details of pump,
 - 1) Method of lubrication (normally the parts of the submersible pumpset are lubricated by the pumped liquid itself. If any other type of lubrication is adopted, it shall be indicated;
 - 2) Minimum bore well diameter in mm;
 - 3) Number of stages;
 - 4) Outside diameter of the bowl, the maximum diameter of the pump fitted with non-return valve and maximum overall diameter of the pumpset including the cable guard, mm;
 - 5) Discharge.....l/s;
 - 6) Total head.....m;
 - 7) Speed.....rpm;
 - 8) Overall efficiency at duty point..... percent; and
 - 9) Minimum submergence at duty point.....m.
- c) Details of motor:
 - 1) Rating.....kW,
 - 2) Type..... in accordance with IS 9283,
 - 3) Details of power supply,
 - 4) Number of poles of motor, and
 - 5) Maximum current at rated voltage and frequency.
- d) Accessories:
 - 1) Suitable starter,
 - 2) Main switches,
 - 3) Ammeter and voltmeter,
 - 4) Pressure gauge,
 - 5) Water level indicating relays,
 - 6) Automatic starting and stopping device,
 - 7) Reflux valve and sluice valve, and
 - 8) Erection clamps and special spanners, if any.
- e) Additional information to be furnished with the supply, if required.

- 1) Performance curves:
 - i) Discharge vs head curve,
 - ii) Discharge vs overall efficiency,
 - iii) Discharge vs current,
- 2) Instructions for installation and maintenance, and
- 3) Weight of the pump motor together in kg and that of cables in kg/m length.

Lot Size	Sample Size
0 to 7	1
8 to 15	2
16 to 25	3

14 TESTING AND INSPECTION

14.1 Pump Tests

14.1.1 Sampling

The sampling shall be as specified in IS 10572 except for lot size up to 25. The sampling for lot size up to 25 shall be as given below:

14.1.2 Laboratory Tests

Testing procedures as given in IS 11346 shall be followed. A typical testing arrangement for submersible pumpset is given in Fig. 3.

14.1.2.1 Measurement of flow shall conform to 2.1 of IS 11346.

14.1.3 Head Measurement

14.1.3.1 Measurement of total head (see Fig. 3)

The total head is made up of:

- a) Vertical distance between pumping water level to gauge centre distance in metres (Z).

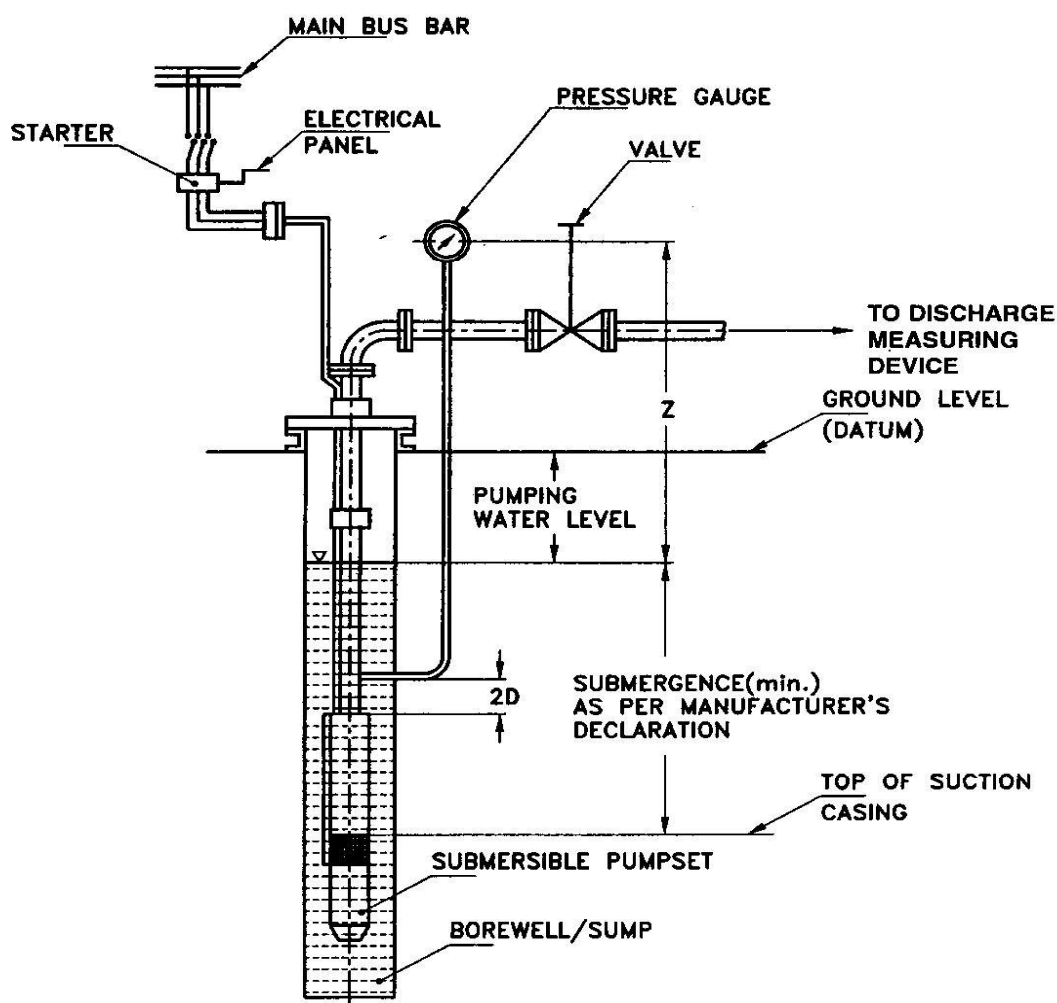


FIG. 3 TYPICAL TESTING ARRANGEMENT FOR SUBMERSIBLE PUMPSETS

- b) Delivery gauge reading in metres in water column (h), and
- c) Velocity head in metres ($Vd^2/2g$).

Therefore, total head $H = Z + h + Vd^2/2g$.

14.1.4 Power Measurement

Watt meter of adequate capacity shall be used.

15 GUARANTEE

15.1 Guarantee of Workmanship and Material

The pumps shall be guaranteed by the manufacturer against the defects in material and workmanship under normal use and service either for a period of at least 15 months from the date of despatch or 12 months from the date of commissioning, whichever is earlier.

15.2 Guarantee of Performance

The pumpsets shall be guaranteed for their performance of the nominal volume rate of flow, nominal head, and overall efficiency.

NOTE — The pumpset shall be guaranteed at the nominal duty point. The same pumpset may also be deemed to have met the guarantee if the users' required duty point lies within the specified tolerance of head (± 4 percent) and discharge (± 7 percent) of the nominal duty point and also meets the non-overloading requirements.

15.2.1 The pump shall be tested for operating head range. However, it shall not be less than + 10 percent and – 25 percent of the rated head. Below 30 m, the limits shall be from + 10 percent to – 25 percent or ± 3 m, whichever is less. In the above head range, the motor shall not get overloaded. The criteria for checking non-overloading shall be that maximum current in operating head range shall not exceed the limits specified in Table 1, for various ratings.

NOTES

1 Pump performance shall be declared at rated voltage and rated frequency. Following affinity laws shall be applied for correction of performance at rated frequency.

$$Q \propto f$$

$$H \propto f^2 \quad (\text{where } f = \text{supply frequency})$$

$$P \propto f^3$$

No correction shall be applied for overall efficiency.

2 Performance at rated voltage and supply frequency is actual performance of the set. This is better than performance at rated

speed, since in the entire operating head range speed of motor is higher than rated speed, as motor is running in underloaded condition.

15.2.2 The minimum efficiency of the submersible pumpset at duty point declared by the manufacturer shall be as given in Fig. 4 and Fig. 5.

15.3 Verification of Guarantee

Guarantee shall be as given in 7, 7.1 and 7.2 of IS 11346, for rate of flow, head and efficiency. The non-overloading requirement shall be checked with respect to the current mentioned in col 3 of Table 1.

16 MARKING

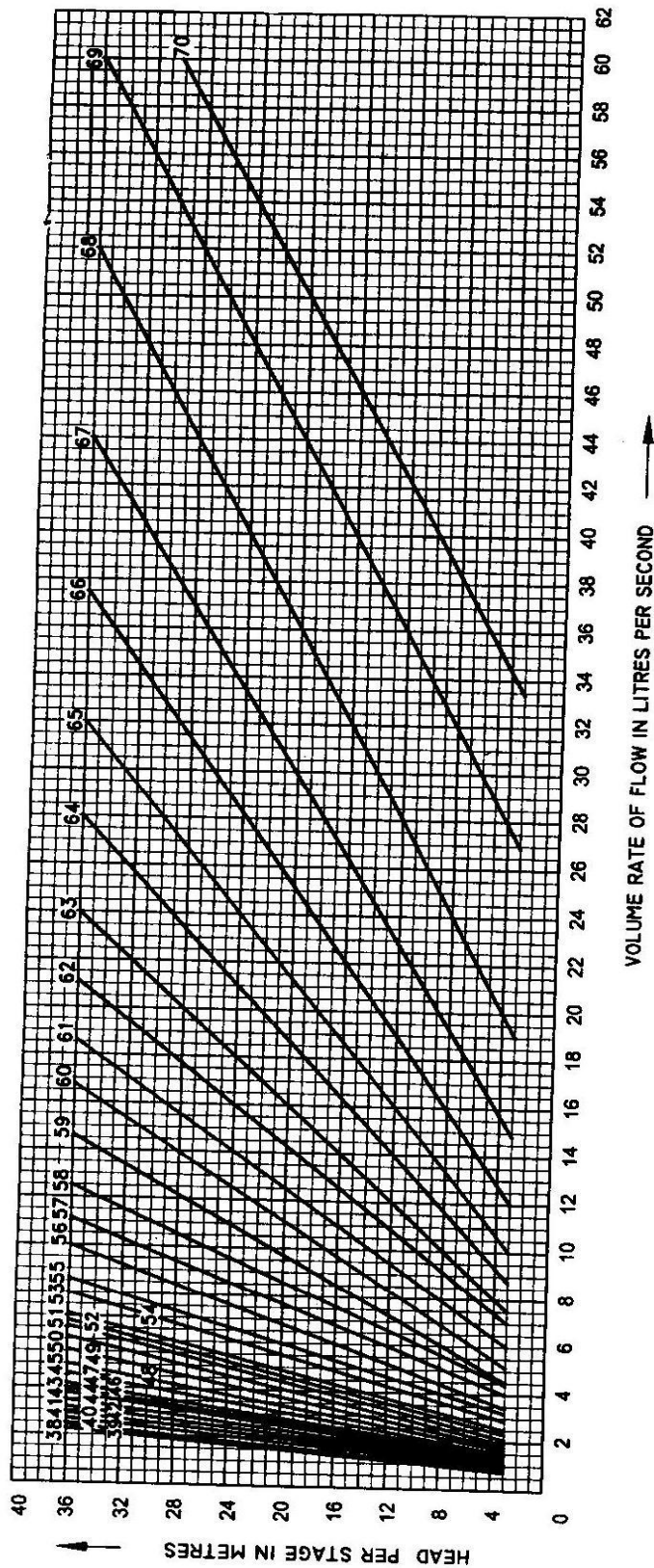
16.1 A name plate of corrosion-resistant material shall be affixed on the pumpset with the following details:

- a) Manufacturer's name or trade-mark, if any;
- b) Model;
- c) Serial No.;
- d) Number of stages;
- e) Bore size, *Min*;
- f) Head, at nominal duty point;
- g) Discharge, at nominal duty point;
- h) Overall efficiency;
- j) Motor rating (kW);
- k) Rated speed (rpm);
- m) Maximum current (amp);
- n) Rated voltage (V) with variation;
- p) Rated frequency (Hz);
- q) Connection star/delta;
- r) Type of duty (whether continuous or not);
- s) Delivery size; and
- t) Head range for non-overloading requirements.

16.2 BIS Certification Marking

16.2.1 The submersible pumpsets may also be marked with BIS Standard Mark.

16.2.2 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers, may be obtained from the Bureau of Indian Standards.

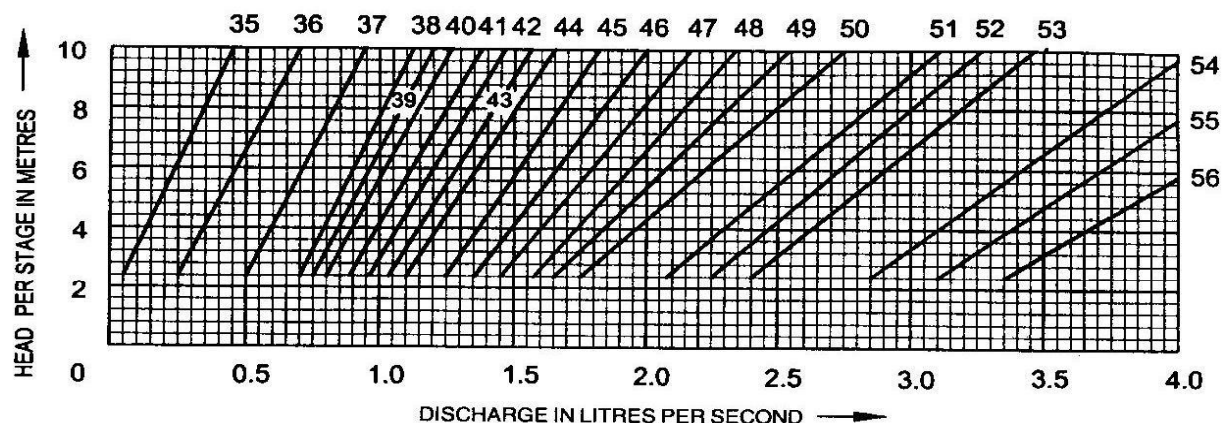


NOTES

- 1 The efficiency in figure represents three or more stages:
 - a) For two stage pump, multiply efficiency given by a factor 0.98.
 - b) For single stage pump, multiply efficiency given by a factor 0.97.
- 2 The motor efficiency factor of motor ratings below 1.1 kW and above 15 kW shall be as declared by the manufacturer. The motor efficiency factor of motors used with pumpsets suitable for bore sizes more than 200 mm shall be as declared by the manufacturers but it shall be not less than the motor efficiency factor of motors of same rating for 200 mm bore size.
- 3 For overall efficiency of the pumpset, multiply pump efficiency by corresponding motor efficiency factor as given above.
- 4 The efficiency chart includes non-return valve losses.
- 5 Efficiency of the pumpsets having declared duty points beyond the efficiency lines on either side may be declared by the manufacturer and applicable tolerance applied. Where the point lies in between the efficiency lines, the higher value be taken as minimum efficiency.
- 6 The motor efficiency factor of single phase motors shall be declared by the manufacturer and applicable tolerance for overall efficiency applied.

Motor Rating kW	Three Phase Motor Efficiency Factor		
	Nominal Bore Sizes in mm		
	100	150	200
1.1	56	57	-
1.5	60	66	-
2.2	63	67	69
3	63	67	69
3.7	64	68	70
4.5	-	70	72
5.5	-	73	75
7.5	-	74	76
9.3	-	75	77
11	-	76	78
13	-	77	79
15	-	78	80

FIG. 4 MINIMUM EFFICIENCY IN PERCENT FOR (2-POLE) SUBMERSIBLE PUMPSET



Motor Rating kW	Three Phase Motor Efficiency Factor		
	Nominal Bore Sizes in mm		
	100	150	200
1.1	56	57	—
1.5	60	66	—
2.2	63	67	69
3	63	67	69
3.7	64	68	70
4.5	—	70	72
5.5	—	73	75
7.5	—	74	76
9.3	—	75	77
11	—	76	78
13	—	77	79
15	—	78	80

NOTES

1 The efficiency in figure represents three or more stages:

- For two stage pump, multiply efficiency given by a factor 0.98.
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3 For overall efficiency of the pumpset, multiply pump efficiency by corresponding motor efficiency factor as given above.

4 The efficiency chart includes non-return valve losses.

5 Efficiency of the pumpsets having declared duty points beyond the efficiency lines on either side may be declared by the manufacturer and applicable tolerance applied. Where the point lies in between the efficiency lines, the higher value be taken as minimum efficiency.

6 The motor efficiency factor of single phase motors shall be declared by the manufacturer and applicable tolerance for overall efficiency applied.

FIG. 5 MINIMUM EFFICIENCY IN PERCENT FOR (2-POLE) SUBMERSIBLE PUMPSET

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
210 : 1993	Grey iron castings — Specification (<i>fourth revision</i>)	9283 : 1995	Motors for submersible pumpsets — Specification (<i>first revision</i>)
318 : 1981	Specification for leaded tin bronze ingots and castings (<i>second revision</i>)	10572 : 1983	Methods of sampling for pumps
2800	Code of practice for construction and testing of tubewells/borewells:	11346 : 2002	Code of acceptance tests for agricultural and water supply pumps (<i>first revision</i>)
(Part 1) : 1991	Part 1 Construction (<i>second revision</i>)	11723	Mechanical vibration — Balance
(Part 2) : 1979	Part 2 Testing (<i>first revision</i>)	(Part 1) : 1992	quality requirements of rigid rotors:
5120 : 1977	Technical requirements for rotodynamic special purpose pumps (<i>first revision</i>)		Part 1 Determination of per- missible residual unbalance (<i>first revision</i>)
6603 : 2001	Stainless steel bars and flats — Specification (<i>first revision</i>)	14536 : 1998	Selection, installation, operation and maintenance of submersible pumpset — Code of practice
6911 : 1992	Stainless steel plate, sheet and strip — Specification (<i>first revision</i>)		

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Amendments Issued Since Publication

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